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Satellizing Galileo? Non-state authority and interoperability standards in the European Global Navigation Satellite System

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Satellizing Galileo? Non-state authority and interoperability standards in the European Global Navigation Satellite System

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Abstract

This article explores the extent and limits of non-state authority in international affairs. While a number of studies have emphasised the role of state support and the ability of strategically situated actors to capture regulatory processes, they often fail to unpack the conditions under which this takes place. In order to examine the assumption that market power, backed by political support, equates with regulatory capture, the article analyses the interplay of political and economic considerations in the negotiations to establish worldwide interoperability standards needed for the development of Galileo as a genuinely European global navigation satellite system under civil control. It argues that industries supported and identified as strategic by public actors are more likely to capture standardisation processes than those with the largest market share expected to be created by the standards. This suggests that the influence of industries in space, air and maritime traffic control closely related to the militaro-industrial complex remains disproportionate in comparison to the prospective market of location-based services expected to transform business practices, labour relations and many aspects of our daily life.

Keywords: Non-state actors, private authority, regulatory capture, standards, global navigation satellite systems.

Résumé

Cet article s'intéresse à l'étendue et aux limites de l'autorité non étatique dans les relations internationales. Alors qu'un certain nombre d'études ont souligné le rôle du soutien étatique et de la capacité des acteurs stratégiquement positionnés à capturer la régulation, elles omettent souvent de décrypter les conditions dans

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lesquelles se déroule ce processus. En vue de tester l'hypothèse selon laquelle le pouvoir du marché, au bénéfice du soutient étatique, mène à une capture réglementaire, cet article analyse les arbitrages entre considérations politiques et économiques dans les négociations en vue de définir des normes internationales d'interopérabilité nécessaires à la mise en place du projet européen de système de positionnement par satellites Galileo. Les résultats mettent en lumière que les industries identifiées comme stratégiques et soutenues par des acteurs publics sont plus à même de capturer les processus de normalisation que celles susceptibles de bénéficier d'une plus grande part du marché générée par l'adoption de ces standards. Ils soulignent d'autre part que l'influence de l'industrie spatiale ou du contrôle du trafic aérien et maritime, étroitement lié au complexe militaro-industriel, demeure disproportionnée en comparaison du marché potentiel que représentent les autres services de géolocalisation susceptibles de transformer les pratiques commerciales, les relations de travail et d'autres aspects de notre vie quotidienne.

Mots-clefs : acteurs non étatiques, autorité privée, capture de la régulation, standards, normes, système de positionnement par satellites

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Introduction

Global navigation satellite systems (Inside GNSS) have become a key element of infrastructure in the development of mobility and transport systems supporting public and commercial services. In 2001 the European Commission and the European Space Agency launched the Galileo programme to create a genuinely European civilian alternative to the American Global Positioning System (GPS) and the Russian GLONASS radionavigation signals, both operated under military control. Based on private funding and a complex private-public partnership, the project notoriously failed to achieve any significant progress for years. In 2008 a major shift in funding and governance structures resuscitated the programme with a strong financial and institutional implication of the European Commission.

This paper analyses the Galileo program from the standpoint of the standards seen as essential for the development of this new global navigation satellite system[1]. It differs from conventional analyses, which for the most part examine the significance of the project in terms of strategic and sovereignty issues (Barlier, 2008; Desingly, 2006; Lewis, 2004; Lindström and Gasparini, 2003; Lungu, 2004; Piéplu and Salvatori, 2006). Economic studies regard standards as crucial means to foster innovation, reduce product variety, and lower market uncertainty in security and quality for the delivery of goods and services to the customer. As information available to producers and consumers is more highly asymmetric in markets for services than for goods, standards are conceived as market tools to overcome an inherent lack of transparency and trust in services prone Yet, those studies fall short of understanding the wider institutional environment and power configurations within which standards are expected to bolster and discipline the international market of services.

In contrast, recent scholarship in international political economy views standards as privatised regulatory regimes competing with conventional power structures and rule-making processes (Borraz, 2007; Clapp, 1998; Graz, 2006; Heires, 2008; Mattli and Buthe, 2011; Murphy and Yates, 2009; Prakash and Potoski, 2010). It highlights the ability of non-state actors to exert a new form of private authority on a range of issues which would previously have fallen within the ambit of state regulations or intergovernmental conventions (Avant, et al., 2010; Büthe, 2010; Cutler, et al., 1999; Djelic and Sahlin-Andersson, 2006; Grande and Pauly, 2005; Graz and Nölke, 2008; Krause Hansen and Salskov-Iversen, 2008). Among factors that make such new form of power effective, studies emphasise the explicit or implicit recognition by the state or by public actors such as the European Union (the so-called state support hypothesis). Another is the ability of strategically situated actors to take advantage of rules devised in small and informal institutional platforms (the so-called regulatory capture hypothesis). From this perspective, the weak support of the European Commission in the funding and governance structure of the initial Galileo project would explain the inability of large multinational firms to identify clear areas in which they could benefit from the huge investments needed to develop interoperability standards for the European satellite radionavigation system. Yet, the political backdrop of the power of non-state actors and large multinational firms to set standards within conflicting definitions of market requirements deserves further attention. More specifically, the case of Galileo should help us to better understand non-state authority in international relations by responding to

[1] The data presented in this paper are drawn from interviews with top officials in charge of standardisation and regulatory policies for Galileo, printed and Internet-documents published by the institutions to which the interviewees belong and by other bodies, and as well as the specialised press, media and other documentary sources.

the following four questions: 1) What exactly is the role of state support, intergovernmental organisations and supranational institutions for firms competing between each other in defining standards? 2) Do firms systematically capture the state by taking advantage of informal institutional mechanisms such as standardisation processes? 3) What is the relation between state support and capture in the ability of previous state-market relationship to prevail in large technical innovation policies? 4) What is the distinct sectoral feature of this relation, in other words, are some sectors more able than others to dominate such practices?

This article provides tentative answers to such questions by exploring the power configurations in the development of standards ensuring large scale technical innovation policies in strategic domains. It focuses on the upcoming European global navigation satellite system and its expected worldwide interoperability to engage the assumption that market power equates with political capture. The article argues that the non-state authority of technical standards relies on strong state support that gives licence to wide capture practices. Yet, in exploring into more detail the relation between state support and capture, it differs from recent analyses of regulatory capture outcomes (see e.g. Mattli and Woods, 2009) by providing evidence that, even in absence of broad societal claims, industries identified as strategic by public actors are more likely to take advantage of standardisation processes than those with the largest market share expected to be created by the standards. With respect to the creation of Galileo as a global navigation satellite system under full civilian control, this suggests that the influence of so-called critical sectors in space, air and maritime traffic control is disproportionate in comparison to their market share, much smaller than those location-based services expected to transform fundamentally business practices, labour relations and many aspects of our daily life.

The article begins with some background on Galileo and the current shift in transport, navigation and location systems supported by satellite positioning. The second section reviews existing literature on service and interoperability standards which play an essential part role in the Galileo programme. The third section develops the theoretical framework and specifies the two core issues of state support and regulatory capture around which the empirical analysis of section four is systematically structured. The conclusion wraps up the argument and draws lessons for future research.

Galileo: some background on a revolution in transport, navigation and location services

Global navigation satellite systems are one of the main pillars of technical innovations in transport, navigation and location services spanning many domains. They consist of a constellation of satellites on orbit around the Earth emitting on a permanent and worldwide basis signals determining very accurate positions in time and space. Those signals can be picked up by receivers operated by different types of intermediary- and end-users for determining their exact position (Piéplu and Salvatori, 2006). Satellite navigation systems were developed over the last 30 years or so, originally for military purposes. In the early 1990s, as the American GPS and Russian GLONASS moved towards an opening of their systems to the civil domain, the European Union saw the need to develop its own system. Satellite positioning has become a fundamental instrument for ship and aircraft crews, train conductors, professional and private drivers; it has also become a tool increasingly used in mining and oil prospecting, agriculture and fisheries, insurance, and many other location-based services. According to the European agency supervising the

Galileo programme, the concrete application of satellite navigation is extremely diverse: it "can relieve traffic conditions by improving the efficiency of vehicle use. It can guide people with disabilities or locate shipments, animals and containers. It can facilitate civil protection operations in harsh environments, speed up rescue operations for people in distress, and provide tools for coastguards and border control authorities. It is also a formidable instrument for 'time stamping' of financial transactions, scientific research in meteorology, geodesy, earth movement monitoring and many other activities"(European GNSS Supervisory Authority, 2009a).

Whilst global navigation satellite systems rely on enormous technical challenges, such technical innovation and delivery of location-based services raise a number of economic, political, and social issues, all of which involve public and private actors on a domestic, intergovernmental and transnational basis. These elements contribute to shaping the basic attributes and the larger scope of the services expected to be provided by satellite positioning. The choice made by the European Union to keep Galileo under strict civilian control has instigated extra efforts to find ways to create a competitive edge with the already existent Russian GLONASS system and especially the leading American GPS. A major challenge for Galileo is therefore to be able to engage three well-known weaknesses of the GPS. First, the accuracy of the transmitted signal is a key issue, as first generations of GPS signals were not able to provide accurate data under 20 meters for civilian applications. The reliability of the signal is another recurring concern: military control over the GPS always means a potential denial of access for strategic or diplomatic reasons, as Iran or Serbia have known too well for years. Finally, the GPS is also known for a number of snags regarding the accessibility to the system in difficult environments, such as high-rise buildings or interfering waves.

The technical advantage expected from the future European global navigation satellite system against its competitors results from the ability to use the signals transmitted by several navigation systems together, instead of relying solely on the open signals of one system[2]. In the words of the European body in charge of the programme, "with its full complement of satellites, […] European GNSS will deliver much more precise and much more reliable services than the American and Russian systems. This […] will make possible a whole new and virtually limitless range of 'reliability-critical' services, applications and business opportunities" (European GNSS Supervisory Authority, 2009a). In order to provide a new range of services more accurate, reliable and accessible than those only depending on the prevailing American and Russian signals, a crucial feature of the Galileo program is to be compatible and interoperable with other global navigation satellite systems. As emphasised by a recent report from the International Committee on Global Navigation Satellite Systems from the UN Office for Outer Space affairs:

> Global and regional system providers agree that at a minimum, all GNSS signals must be compatible. To the maximum extent possible, open signals and services should also be interoperable, in order to maximize benefit to all GNSS users. […] compatibility and interoperability are highly dependent on the establishment of standards for service provision and user equipment (International Committee on Global Navigation Satellite Systems, 2009, p. 5).

[2] According to the International Committee on Global Navigation Satellite Systems from the United Nations Office for Outer Space Affairs, interoperability is defined as: "the ability of global and regional navigation satellite systems and augmentations and the services they provide to be used together to provide better capabilities at the user level than would be achieved by relying solely on the open signals of one system". See: http://www.oosa.unvienna.org/oosa/en/SAP/gnss/icg.html, accessed 22 August 2009.

On empirical grounds, interoperability standards were, from the outset, identified as a strategic underpinning of the programme on both a horizontal and vertical basis. On a *horizontal basis*, interoperability standards shape the infrastructure of geo-localisation. They define the extent to which distinct satellite radio-navigation systems are compatible and can rely on each other. In 2001, a progress report prepared for the European Commission indicated that "the main concerns of the US authorities relate to ensuring GPS favourable interoperability, competition and standardisation arrangements. The Commission aims for a level playing field in GNSS overall and maintains that two systems backing each other up are today more necessary than ever to reduce vulnerability"[3]. Today, the European agency supervising the Galileo programme considers that European independence was a chief reason for launching the programme. It emphasizes, however, that, "by being interoperable with GPS and GLONASS, Galileo will also be, in a very real way, the new cornerstone of the global navigation satellite system" (European GNSS Supervisory Authority, 2009b). On a *vertical basis*, interoperability standards shape location-based services. They specify the requirements for producing and transmitting signals used in material and/or software applications developed for the delivery of services to end-users. They are largely used in air, rail, maritime and private vehicles traffic control; they have become core functions of mobile phones for navigation information; they are expected to become the backbone of the wide range of the above-mentioned location-based dedicated services. The European Commission and European Space Agency differentiates among this wide variety of uses between "critical" or "non critical" applications: critical applications involve potential security issues for human life, especially in air, rail and maritime sectors and require the highest level of signal integrity and alerting devices in case of failure of the system. In contrast to the so-called "Open service" available for free to all users, four classes of signal respond to critical applications with restriction of access (European Parliament and Council of the European Union, 2008; European Space Agency, 2005).

Standardising the signals used in satellite navigation and their interoperability with other systems providing information to receivers for all sorts of location-based services to end-users obviously requires intricate leading-edge scientific knowledge in information, communication and navigation technology. Yet, interoperability standards for satellite navigation services also hinge on the broader institutional environment devised for setting complex technical specifications. The scope and the nature of such standards comprehensively affect the current and future organisation of the capitalist economy.

Why service and interoperability standards matter

Standards are voluntary technical specifications explicitly documented and published for organising the production and exchange of goods and services. While a number of them are defined within the International Organisation for Standardisation (ISO) framework, others result from agreements reached within private consortia, such as the Code division multiple access standards of the CDMA Development Group competing the GSM technology in radio-telecommunication. Such a wide range of complex and informal institutional mechanisms used as tools in the organisation of production and exchange of services on a worldwide scale have significant impact on the relation between the economic and political spheres of our societies.

[3] Commission Staff Working Paper, *Progress Report on the Galileo Programme*, Brussels, 5 December 2001, SEC(2001)1960, p. 5.

Scholarship on standards is dominated by business, economic, organisational and applied science studies focused on standards in goods and their relations with industrial choices, market forces, and technological innovation (Blind and Egyedi, 2008; Cargill, 1989; Drèze, 1989; OECD, 1999; Swann, 2000; Toth, 1984; Vries, 1999). The ability to develop a global market of services is not just a matter of corporate decisions, economic constraints and technology. A more sociological and political perspective assumes that international standardisation requires a distinct institutional framework to ensure some order at the transnational level. A number of neo-institutionalist studies hinge on rational choice and game theories to formalise systematic explanations of cooperative games and conflicts of distribution in the institutional framework of standardisation (Abbott and Snidal, 2001; Mattli and Buthe, 2011; Mattli, 2001). Some of them build analytical frameworks that attempt to overcome models of mere supply and demand of private regulation by differentiating between demanders, suppliers, and targets of private regulation (Büthe, 2010). Others adopt a reflexive perspective on the socially and historically constructed framework of standardisation and its diversity across the globe. They provide accounts of the formation of the institutional architecture of standard-setting, beliefs underpinning standards, democratic controls of so-called independent regulatory authorities, conflicts of power in specific negotiations, or the broader scope of ISO-like standards (Brunsson, et al., 2000; Egan, 2001; Nicolaïdis and Egan, 2001; Schmidt and Werle, 1998). Yet, most of them fail to recognise the broader scope and structural nature of power relationships affected by standardisation and the role it plays in the organisation of a capitalist world economy.

One of the clearest way in which standards can exert a distinct form of domination is in their ability to reinforce path-dependant oligopolistic trajectories in technological innovation. Studies in technological change and innovation inspired by the evolutionary political economy of Schumpeter and Veblen provide significant insight on this comprehensive scope of power relations in standardisation processes (Callon, 1991; Cowan, 1991; David, 1995). From this point of view, standardisation reflects a cumulative and evolutionary process of collective appropriation with significant incidence on market power and competition. Short of exclusive exploitation rights included in patents, standards codify technical specifications regarding measurement, design, performances, or side effects of products, industrial processes, and services that de facto exclude alternative technology and contending processes. Innovative technology conforming to such standards often includes patented technology, especially in large-scale and forward-looking industrial policies such as in global navigation satellite systems. Whilst the supporting or impeding effects of standards on innovation remains disputable (Liebowitz, et al., 2002), such a Schumpeter-inspired approach provides a persuasive explanation of regulatory capture induced by technological lock-in effects. Large firms dominating matured markets are likely to use standards as artefacts for maintaining their domination on distinct technologies (Dudouet, et al., 2006, p. 19). Yet, the role of states and intergovernmental organisations in supporting the ability of those firms to define standards in such ways deserves further attention. Moreover, a crucial question remains almost wholly unanswered: do big firms systematically control trajectories in technological innovation? If not, which ones do, and how do they rely on standards to do so? This prompts us to elaborate further on the non-state authority of international standards.

The non-state authority of international standards

International relations and global political economy scholarship on the rise of non-state actors, private authority and less conventional forms of sovereignty and governance has mushroomed over the last decade (Avant, et al., 2010; Büthe, 2010; Cutler, et al., 1999; Djelic and Sahlin-Andersson, 2006; Grande and Pauly, 2005; Graz and Nölke, 2008; Krause Hansen and Salskov-Iversen, 2008). They prompted a shared understanding on the importance of implicit or explicit consent – instead of coercion or forceful compliance – in such configurations of power. According to Cutler and her co-authors (1999, p. 19), "those subject to the rules and decisions being made by private sector actors must accept them as legitimate, as the representations of experts and those 'in authority'". In the same vein, Djelic and Sahlin-Andersson (2006, p. 23) consider that non-state authority enabling various forms of transnational governance hinges upon "powerful institutional forces that altogether constitute a transnational culture or meaning system". As Djalic and Quack (2010, p. 386-7) emphasise, actors in charge of this new form of authority can be understood as transnational communities that "reveal the existence of integration, socialisation and control mechanisms. Many of these mechanisms appear to be quite similar, in fact, to the mechanisms generally at work in the construction of national or even local imagined communities."

The non-state authority of international standards reflects a form of structural power. The concept of structural power refers to material and discursive structures able to affect intentionally and unintentionally the practices of agents. Those able to wield this power can modify the general environment for their own benefit. The importance of consent in a structural understanding of power on a global scale and the extensive concept of the state stretching out to civil society actors have been widely recognised in Gramscian-inspired interpretations of hegemony. Robert Cox pioneered this line of reasoning in studying large-scale historical structures, as well as the smaller *nébuleuse* of official and unofficial transnational and international networks working together towards the formulation of a consensual policy for global capitalism (Cox, 1987, 1992). The introductory survey of the International Organisation for Standardization by Murphy and Yates explicitly embraces the Gramscian analytical lens to explain how low-profile voluntary consensus based standards can have significant impact on social regulation (Murphy and Yates, 2009).

The Gramscian-inspired IPE scholarship is appropriate to point out the overall coherence in which situating the relationship between state and non-state actors in standardisation processes. One should be careful, however, not to overstate the totalizing effect of structural power (Germain and Kenny, 1998)[4]. The rise of non-state actors and less conventional forms of sovereignty is certainly not boundless and all-inclusive. From an analytical perspective, a Gramscian-inspired approach would single out two distinct features supporting or impeding the power configurations of interoperability standards in the domain of global navigation systems: one refers to the role of state support, intergovernmental organisations and supra-national institutions in the competition between firms to define standards with enough consensus to claim wide recognition; the other refers to the particular interests behind such claims to general interests in the ability of those state-supported firms to take advantage of those particular institutional mechanisms. The following analysis sketches out those two theoretical issues by examining into more detail i) the explicit or implicit recognition by the state; ii) the oligopolistic form of

[4] For a similar reflection on the G20 in the context of the current crisis, see also (Beeson and Bell, 2009)

competition favouring state and regulatory capture by strategically situated actors, such as large multinational firms.

i) The ability of non-state actors to cooperate across borders to establish rules and standards accepted as legitimate by agents not involved in their definition requires an explicit or implicit state recognition. States remain central in the rise of private actors in both domestic and international affairs. While there may be sharp disagreements as to the sense attributed to state recognition, there is little disagreement concerning the overall complementary and subsidiary role taken by private actors in regard to state functions. This assumption sharply differs from the conventional view according to which "It is the inability or unwillingness of states to adopt or enforce [effective government controls over global firms and markets] that has contributed to the development and growth of non-state based governance institutions" (Vogel, 2009, p. 160). Governments and intergovernmental institutions often support and fully recognise the power of non-state actors, who in turn may gain legitimate authority. As Sassen (2006, p. 170-1) argues, 'the redistribution of power within the state is a consequence of changes in both the national and the international political economy but is also constitutive of those changes'. This explains the limits within which this phenomenon should be understood as a purely private form of collective action. In short, the question is not so much whether non-state authority is embedded in state institutions and international institutions, but rather in which institutions, at which level, granted with what kind of enforcement. As a genuinely European alternative to other global navigation satellite systems, Galileo is without doubt a typical case to probe in more detail how the development of technical specifications and standards are embedded in existing European institutions as well as ad-hoc governance structures specifically created for supporting the program.

ii) The non-state authority of international standards hinges upon an oligopolistic form of competition which tends to favour state and regulatory capture. Concerns about the ability of special interests or small groups of powerful firms to seize the common interest of regulation are central in the wide range of studies focused on regulation policy. This is even more the case at the international level, where powerful actors have become increasingly proactive in influencing regulation outcomes and devising self-regulatory frameworks of the global economy (Braithwaite and Drahos, 2000). Early public choice approaches emphasised the importance of self-interest in regulatory policies and how well-organized actors can capture the state (Peltzman, 1974; Stigler, 1971; Wilson, 1980). In contrast, though following the same rationalist vein, principal-agent models consider that regulatory practices of non-elected bodies and private actors are often unable to capture the state (Jordana and Levi-Faur, 2005; Majone, 1996; Vogel and Kagan, 2004). From an institutional rationalist perspective focused on supply- and demand-side conditions influencing regulatory outcomes, Mattli and Woods (2009, p. 15) reach a more nuanced position by identifying different outcomes ranging from pure capture to common interest regulation; they stress in particular that the "supply of proper due process mechanisms is not enough to ensure common interest regulation […] In the absence of broad societal demand, industry and other concentrated groups targeted for regulation may be the most frequent users of due process channels […] and thus may succeed in influencing the fine details of regulation to benefit themselves".

Such explanations undoubtedly provide fruitful avenues for understanding actors' behaviour and expected outcomes of regulatory policies. Yet, they are all framed within a rationalist understanding of collective action and a positivist standpoint on knowledge creation. From a reflectivist perspective, actors have only a limited capacity to respond to their institutional environment, which itself reflects deeper and contradictory structures; similarly, as any given social reality contributes to

give meaning to its own existence, knowledge and inference drawn from observed facts not only are shaped by those facts, but also contribute to shape them. As Cameron and Palan recently stressed, this does not precludes a "possibility of an IPE that is simultaneously critical and rigorous both in theoretical and methodological terms" (2009, p. 113); to this end, we should assume that our conceptual tools can be heuristic and descriptive, and in the same time socially and historically-dependant.

This is certainly a critical point to sharpen up the argument that market power equates with political capture. The equation can greatly vary along positions in the oligopolistic environment. As we have seen, a Schumpeter-inspired evolutionary understanding of standards points towards their use by large firms dominating mature markets for capturing technical innovation. In the domain of global navigation satellite systems, companies providing infrastructure services (i.e. the transmission of the signals) and most industries involved in the hardware and software instruments of satellite navigation (i.e. receptors) are not situated on the same segment of market maturity as those delivering commercial location-based services to end-users (i.e. positioning and mobile-related applications used for instance in emergency services). Most companies providing infrastructure and navigation services belong to the more mature market of the militaro-industrial complex than those new firms providing highly personalised and mobile information to end-users for dedicated location-based services. As Mügge (2006) has shown in much detail with regard to the financial sector, it is much easier for private actors to promote self-regulation and non-state forms of standardisation when only a few big players remain in place after having settled early competitive struggles for the control of a new market. In this perspective, incumbent firms belonging to mature markets tend to be more prone to political capture than those struggling in highly competitive innovative markets. The following analysis provides further evidence of the significance of an oligopolistic environment, characterised by limited competition between large firms related to past industrial space policies closely associated with national militaro-industrial complexes and Raison d'Etat.

In brief, the analysis of how the non-state authority of international standards can be effective requires a detailed understanding of the explicit or implicit state and intergovernmental recognition and the form of competition supporting the ability of market power to equate with political power. The next section examines the extent to which these issues affect the development of the interoperability standards required for launching a European global navigation satellite system expected to dispute the first mover's advantage of the American GPS system.

Galileo and its search for standards

In this section, we focus on three core issues underpinning the development of Galileo standards:

(i) The competition between European private firms in the development of Galileo's *geo-localisation infrastructure*, which shows the ability of state-supported firms to indirectly capture standardisation processes, without participating in the formal institutions governing the project;

(ii) The development of *horizontal interoperability standards* between competitors in global navigation satellite systems, which shows that a strong market share can, but does not necessarily, ensure dominance in the standardisation process;

(iii) The development of *vertical interoperability standards* between Galileo and location-based services for end-users, whose ability to influence the standardisation process is inversely proportional to their market share.

(i) Public actors such as European Union (EU), European Space Agency (ESA) and Eurocontrol have been driving the Galileo project since its beginnings in the 1990s. European states were aware of the economic, technological and political ascendancy that American space systems could gain in the context of the demise of the Cold War. Two reports of European Commission and one of the main lobbying organisation of European space industries (High Level Industry Working Group – HLIWG) emphasised three threats: a "major dependence" of Europe on the American military GPS system, a lack of European companies in the international GNSS market, and poor perspectives for European industry to "capture the huge associated market for user equipment" (Bildt, et al., 2000; European Commission, 1994, 1996; HLIWG, 1996). As Lungu points out, "European elites have been worried since the late 1980s that they would not be a winner in the kind of Schumpeterian competition that characterizes typical technology-intensive industries such as the aerospace" (2004, p. 382). European Commission and some European countries considered a solution was urgently needed to avoid the loss of critical growth markets by space industry firms. After various declarations of interest, the European Commission officially launched the project in 1999.

The initial project designed a Public Private Partnership (PPP) and the delivery of a concession to a private firm, with a development phase funded by the European Union (Mörth, 2007). In 2002 the European Union and the European Space Agency (ESA) created the Galileo Joint Undertaking (GJU) to be in charge of the development phase and of the completion of future concession assignation contracts (Council of the European Union, 2002). While private firms interested in the GNSS market were supposed to buy shares of the capital of the GJU, not a single one eventually did (Council of the European Union, 2002). The GJU, nevertheless, published in 2003 the call for the concession authorizing the deployment and operational management of Galileo. Two consortia of space industry firms showed their interest: Inavsat and Eurely.[5] As each European state tried to promote its national champion, the two consortia were unable to collaborate and GJU could not make a choice between them (AFP, 2002; Cour des Comptes Européenne, 2009; Eurely & Inavsat, 2005a, b; Sparaco, 2003). They eventually merged to create Euro-GNSS, which negotiated in 2005 a 20 year concession (European Commission, 2006). However, the new partners continued to disagree on their respective share in the project, which was marked with many overlaps in jurisdictions and work packages, as well as increasing doubts on the financial profitability of Galileo[6]. As a result, Euro-GNSS failed to achieve its mandate within the agreed schedule. In 2007 the European Commission cancelled the concession agreement, aborted the initial PPP project, and made a U-turn to fund the development, deployment and operational phases of Galileo for 3,4 billions euros (European Commission, 2007). The whole project was cut into six packages, to be attributed as public procurements to European space industry firms (European Parliament and Council of the European Union, 2008). Under the new framework, all intellectual property

[5] Inavsat was made of Immarsat Ventues (G-B), EADS Space Services (Germany/France), and Thales (France). Eurely was made of Alcatel (France), Finmeccanica (Italy), Aena (Spain), and Hispasat (Spain). For further information, see: (Alcatel Alenia Space, 2005; EADS, 2005)

[6] Eero Ailio, Administrator of Galileo External Relations of the European Commission, interview with authors, 5 May 2008, Brussels; René Oosterlinck, Director of the Galileo Programme and Navigation-related Activities (D/NAV), European Space Agency (ESA), interview with authors, 24 July 2008, Paris.

rights related to the standards developed for Galileo belong to the European Union (European Parliament and Council of the European Union, 2008).

What lessons can be drawn from this story? First, a good deal of the initial failure of the project between 2002 and 2007 under the management of the public/private body Galileo Joint Undertaking (GJU) can be explained by weak state support. Without public funding from the European Union and clear prospects on the business model of Galileo, future earnings extracted from a potential rent remained uncertain for private firms involved in the project. There was no point for organising themselves to capture the body created to launch the project. Instead, space industry firms of the militaro-industrial complex struggled in their own consortium – Inavsat and Eurely – to develop their own standards for Galileo. In other words, private firms tried to capture the project outside the GJU formal structure to gain more significant control over the definition of Galileo's standards.

It is precisely such inability of private actors to cooperate that led the European Commission to reinforce state support. Yet the new framework devised to regain control of Galileo does not mean a total loss of influence for space industry firms. On the contrary, a particular institutional agreement provides an enhanced state support to national firms of the military-industrial complex closely associated with security concerns. In 2007, the European Transport, Telecommunications and Energy Council set up a distinct juridical framework, which strongly restricts the ability of extra-Community contractors to provide their technology to set Galileo standards. According to the European Commission officer in charge of Galileo external relations, non-European firms could only have access to the market if "they supply a clear added value in terms of quality or cost"[7]. A 2008 Regulation of the Parliament and the European Council blessed this assumption:

> "open access and fair competition throughout the industrial supply chain and the balanced offering of participation opportunities to industry at all levels, [...] should be pursued across Member States" and "European industries should be permitted to rely on non-European sources for certain components and services where substantial advantages in terms of quality and costs are demonstrated, taking account, however, of the strategic nature of the programmes and of European Union security and export control requirements"(European Parliament and Council of the European Union, 2008).

In addition, the European Commission gave particular attention to procurement procedures of each segment of the project in the "Galileo technology control regime". The document mentions, among other things, the type and nationality of industrial firms allowed to be involved in the project (European Commission, 2008). According to Coste, "80% of the space technology market is an institutional market. That is to say it is built on public procurement which are assigned exclusively to domestic industries" (2005, p. 22). As Zervos and Siegel (2005, p. 171) explain,

> "European and American firms encounter almost no domestic competition in their respective domestic space industries. However, they do encounter competition in commercial space markets, such as launching services, telecommunication satellites, and remote sensing products. As a result, each firm is assumed to behave as a monopolist in the domestic public space

[7] Eero Ailio, Administrator of Galileo External Relations of the European Commission, interview with authors, 5 May 2008, Brussels.

> market it is faced with, and as a duopolist, in competition with the other firm in the commercial space market."

These *pro forma* Galileo provisions contradict common EU law, in particular the Treaty on European Union, which promotes free competition (European Union, 2008). They tend to create an oligopolistic environment ensuring preferential treatment to large European companies and their subsidiaries. Insofar as European space industry firms (e.g. EADS, Finmeccanica, Thales, etc.) that control the technology standards required for the new GNSS benefit from this tailored juridical framework, they did not need to engage themselves financially into GJU. They just had to wait for orders paid by the European Union to provide their technologies! Moreover, despite a formal European Union ownership, space industry firms will keep the right to use the standards created for Galileo for their own products free of charge (European Parliament and Council of the European Union, 2008)[8]. This form of state-supported capture presents the huge advantage of allowing private firms to develop patented standards for which they will get a competitive advantage without having to pay for their development – an industrial model far from the common understanding of entrepreneurial risk taking. This may well explain the relative lack of concern of European space industry companies to directly control technological and operational aspects of Galileo. The capture here is indirect, without any need to be part of the formal institutions governing the project. This is how the Galileo legal regime has led to a *de facto* capture process for state-supported firms of the European space and militaro-industrial complex.

(ii) The launch of Galileo by the European Union follows the implementation of other similar systems, such as the American GPS or the Russian GLONASS. Interoperability on a so-called horizontal basis is a cornerstone for newcomers in order to be able to use the signals transmitted by other navigation systems. Interoperability agreements are indeed crucial to insure a better accuracy (more satellites available to the end-users), reliability (redundant satellites constellations and use of common radio frequencies without interference), and accessibility (compatibility between different satellites constellations). This technology- and market-driven requisite reflects a paradoxical competitive interdependence, including significant issues on standards and "grandfather rights" of the first mover. This invariably generates a strong dissymmetry between contractors. According to Creti et Perrot (1997), actors in a weak position, such as newcomers, can only consider their survival by building bridges – e.g. by adopting common standards – with their competitors. In contrast, older players can take advantage of this context by guiding their competitors' choices and thus perpetuating their market domination. In the case of Galileo and GPS, Americans initially offered to sell to their European counterparts a "ready to use" GNSS fully compatible with GPS, which clearly promoted their own space industry and maintained their control over any potential competitor[9]. The European Commission turned down the offer, but accepted in a 2004 agreement to adopt CDMA – the signal standard of GPS – for future developments of Galileo (European Union & United States of America, 2004). This allows joint use of both GPS and Galileo signals on a same receiver to make the two satellites' constellations compatible mainly for reliability purposes. For its part, the Russian GLONASS initially tried to adopt another signal standard (FDMA) incompatible with GPS and Galileo. However, in 2008, Russian officials also decided to implement the CDMA standard jointly with their FDMA in order to be compatible with most of the end-users receivers (Engelsberg, et al., 2008; Inside

[8] This was fully explained to us by Eric Chatre, Head of Mission and System Definition, European GNSS Supervisory Authority (GSA), interview with authors, 7 May 2008, Brussels, Belgium.

[9] Eero Ailio, Administrator of Galileo External Relations of the European Commission, interview with authors, 5 May 2008, Brussels.

GNSS, 2007). Thus, unified interoperability standards exert a distinct market pressure on new GNSS entrants for setting compatible standards. Does this, however, inexorably lead to a capture of the market by the first movers of large technical innovations? The Galileo project provides some evidence that this assumption may be nuanced.

GPS is undoubtedly the main and sole current GNSS which provides signals used by all kinds of end-users all over the world. In regard of the overwhelming predominance of the GPS, the wisdom of creating a new GNSS like Galileo has often been questioned among European official circles (Harrison, 2001; Sample, 2007). Apart from strategic and sovereignty issues, and even if some GPS standards such as the CDMA are included in Galileo, why does the European Union need its own GNSS technology? From an abstract political economy perspective bringing together Schumpeter- and Gramscian-inspired approaches, matured industries whose standards control the largest market share (i.e. American space industry firms) are likely to capture the standardisation processes. Yet, a careful empirical investigation of the Galileo project proves that this abstract view should be nuanced. As shown above, the development of European GNSS technologies was defined as a major issue by the European countries since the beginning of the 1990s. After the failure of the initial arrangement, this led European space industry companies to enjoy a strong state support granted by a tailored legislation and strong financial backing to develop their own technologies (European Parliament and Council of the European Union, 2008). As a result, European companies could count on an effective system keeping at bay the domination from American state-supported GPS providers. Even if some American companies were involved in minor parts of Galileo packages, European space firms that were previously unfamiliar with GNSS standards succeeded in undermining the first-mover's capture advantage of US firms in the global GNSS market. This is considerable evidence to reinforce the case that a strong state support is likely to allow private firms to overcome market capture of historic providers in a specific sector.

iii) Securing vertical interoperability with location-based services for end-users is the third key issue underpinning the significance of standards for a successful development of the Galileo program. On a vertical basis, interoperability hinges on the acceptance by location-based dedicated services to receive signals from different GNSS into a sole technical device – a key point for the commercial success or failure of the project. However, as we have seen in section 1, the role of distinct communities of users in the definition of Galileo's standards differs significantly. Some applications, such as in civil aviation, rail transportation, and maritime traffic, are designated by the EU as "critical" for security reasons. They represent, however, only a fraction of all users. For instance, at the beginning of the project, civil aviation was expected to reach only 1% of the market share (Blanchard, 2003, p. 96).

In contrast, non-critical commercial or public applications in location-based services, such those related to mobile phones or car navigation systems, were expected to make up respectively about 32% and 42% of all users (Flament and Ludwig, 2003, p. 12). More recent data on four sectors defined as "key market segments" by the European body in charge of Galileo estimate at 57% the future Galileo market in road navigation and 39% in location-based services – e.g. mobile phone services –, but only at 2,8% in aviation and 1,2% in agriculture (Kennes, et al., 2009). Quite surprisingly, the ability of each community of users to define key features of the service to be delivered is inversely proportional to their market share.

The European GNSS Supervisory Authority (GSA) set up a so-called bottom-up process to directly involve "critical" users in the definition of signal standards. The process relies on the ability of the most important international organizations of the sector, in particular the International Civil Aviation Organization (ICAO), to forward to Galileo promoters requirements in terms of performance of the system and technical standards (Standards and Recommended Practices – SARP) before authorising users such as devices producers or airlines companies to implement Galileo's signals for civil aviation applications (OACI, 2004). The requirements are studied by GSA and ESA in order to be transmitted to firms in charge of the development of Galileo. Most important requests of "critical" users lead to an adaptation of the system's standards. The role of space industry firms in these sectors is significant, since they are often involved in the conception of Galileo's infrastructural standards and of the devices used in applications such as civil aviation (e.g. EADS, Finmeccanica, Thales, etc.). According to high-level officials in charge of the program, the United States even appoint industry representatives in international organizations such as ICAO in order to influence the definition processes of standards' requirements and to ensure that their space industry firms will not be affected by such requests[10].

In contrast, non-critical public and commercial users, such as mobile phone or car navigation system manufacturers (e.g. Nokia, Sony Ericsson, TomTom, etc.), are not directly involved in the definition of Galileo's standards. Here, the GSA relies on a so-called top-down process, according to which GNSS standards are forwarded to industry fora, such as the Open Mobile Alliance or the 3rd Generation Partnership Project[11]. In general, if the high level of requirement of "critical users" is reached, GSA considers that the signal standards provided by Galileo should meet the needs of other users' communities as well[12]. This is why GSA does not modify signal standards for non-critical users' needs. In this sense, GSA assumes the role of gatekeeper. However, sectors like location-based services or traffic management and security are particularly important for public recognition and a mass-market use of Galileo. This brings into focus the announcement made in 2009 by the GSA to create with the support of the European Commission a "Market Development Department" in charge of all issues related to European GNSS market access (Kennes, et al., 2009). There is little doubt that this initiative reflects the dual need of Galileo's market: a genuinely European civilian GNSS must target a mass market of public users in order to be financially viable and symbolically recognised as a major and popular GNSS, yet it must simultaneously adapt its services to specific "critical" users in order to be technologically recognised as a performing and reliable GNSS.

"Critical use" as defined by the EU is thus likely to generate greater capture of standardisation processes by industries, even if their expected market share is low. Privileged arenas for capture are inter-governmental organisations such as the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO). The fact that "critical use" involves state-supported industries defending their interests in international organisations provides us with some useful insights into this particular aspect of non-state authority in standardisation processes. Moreover, sectors defined as "critical" (e.g. civil aviation) are usually the

[10] Eric Chatre, Head of Mission and System Definition, European GNSS Supervisory Authority (GSA), interview with authors, 7 May 2008, Brussels; Eero Ailio, Administrator of Galileo External Relations of the European Commission, interview with authors, 5 May 2008, Brussels.

[11] See : www.openmobilealliance.org/ (accessed 13 November 2008) and http://www.3gpp.org (accessed 12 January 2009).

[12] Eric Chatre, Head of Mission and System Definition, European GNSS Supervisory Authority (GSA), interview with authors, 7 May 2008, Brussels.

same as those in which state-supported space industry firms are involved. Such firms benefit from their oligopolistic position in defining standards, as well as in designing the needs of critical users. This suggests that the categorisation of Galileo users is not only driven by security reasons, but also by strategic industrial policy choices. In contrast, firms lacking state support are left with few levers of influence, even if they are expected to drive most of the market share in the use of Galileo's standards. We are thus witnessing the paradoxical situation where the need for Galileo to have a broad base of users in order to be recognised as a major international GNSS is not captured by those firms expected to benefit from the huge market of location based services, but by those old domestic-oriented champions of the space-related militaro-industrial complex.

Conclusions

The relevance of this study rests on the importance of technical standards as non-state forms of authority in market creation and global regulatory issues that not only need state support, but also supposes a peculiar form of rent seeking. By focusing on the interoperability standards ensuring the development of the geo-localisation services of Galileo and their link with other global navigation satellite systems, the article highlights the ability of non-state actors to gain a new form of authority on a range of issues which would previously have fallen within the ambit of state regulations or intergovernmental agreements. The ability of the most strategically situated actors to define market structures for large-scale technical innovations with worldwide implications still depends on state support. This study provides further insights, however, on the conditions under which state support takes place and non-state actors capture standardisation and regulatory processes. It examines the limits of market power, backed by political support, to equate with regulatory capture.

What are the wider implications of this analysis? On a theoretical basis, the initial failure of the first Galileo Joint Undertaking in 2002-7 has shown that without considerable state support, industrial consortia remain unable to organise themselves sufficiently to capture the regulatory outcome of technical innovation surrounding the creation of a new market. In contrast, the GNSS Supervisory Authority set up in 2008 has benefited from the strong political backing of the European Commission to implement a new framework which has allowed a *de facto* capture process for state-supported firms of the European space and militaro-industrial complex. Our study also specifies neo-Schumpeterian and institutional assumptions on path-dependant oligopolistic innovation trajectories. While American firms controlling a wide range of technologies closely related to the GPS undoubtedly benefit from a first mover's advantage in technical innovation, the successful political backing of the new Galileo framework allowed European firms to contribute to Galileo standards and enter the market. The development of horizontal interoperability standards between competitors provides significant evidence that state support can allow new entrant firms to overcome market capture by historic providers. Moreover, our detailed analysis of the vertical interoperability of standards between the infrastructure of satellite geo-localisation technology and location-based services for end-users shows that further disaggregation of industry practices is necessary to fully understand regulatory capture. Emerging firms expect to predominantly benefit from the new market of location based services, instead of the old national champions of the space-related militaro-industrial complex; yet, they are unable to capture the nascent interoperability standards. Unlike a straightforward structural understanding of capture, this suggests that the ability of market actors to set standards in their own

favour can be inversely proportional to their market share. Political support helped to undermine American-led path-dependant trajectories in shaping the horizontal interoperability of standards between competing satellite navigation systems; in contrast, within the European environment, it reinforced another path-dependency in setting vertical interoperability standards to the detriment of location-based services. Political support played a predominant role in orienting standardisation and regulatory capture in both cases.

On the whole, the power of firms to set in their own favour the technical specifications underpinning new markets cannot be understood independently from how states and political institutions frame their support. This straightforward assumption brings us back to two major issues surrounding the debate on what the IPE field is or should be (Blyth, 2009; Cohen, 2007; Phillips and Weaver, 2010)[13]. First, in sharp contrast to the mainstream US-style understanding of political action affecting economic transactions on the international stage, it reinforces the so-called British or continental perspective on IPE that has a more pervasive definition of power relations. This ontological view of power has roots in a conceptualisation of politics more process- than outcome-oriented and allows investigations into a wider range of state-society relations. This is what Hay and Marsh (1999) meant over ten years ago when they emphasised that putting the P back into international political economy supposes to "interrogate power relations in any social context". The complexities and far-reaching implications of the European global navigation satellite system are clearly a case in point. Second, from a methodological perspective, our careful empirical investigation of how market power can equate with regulatory capture lends support, this time, to calls made by a number of scholars to take American empiricist tradition more seriously. While constructivists long ago emphasised that structures can only be instituted by the practices of agents, the implication here ties in with the critical and historicist tradition of the so-called British and continental IPE. It is from this standpoint that this article endorses an approach echoing the 'critical empiricism' called for by Cameron and Palan (2009). In shedding light on one among many messy issues of the real world, it helps to identify new routes to overcome the empiricist/structuralist divide in knowledge production and validation among IPE scholars.

[13] See also the two following special issues of *New Political Economy*, "The 'British School' of International Political Economy", Vol. 14, No. 3 (2009), pp. 313-400 and *Review of International Political Economy*, "Not So Quiet on the Western Front: The American School of IPE", Vol. 16, No. 1 (2009), pp. 1-143.

References

Abbott, K. W. and Snidal, D. (2001). "International 'standards' and international governance", *Journal of European Public Policy* 8(3): 345-370.

AFP (2002). "German-Italian row could scupper Galileo satellite project: Prodi", *Agence France Presse,* 3 October.

Alcatel Alenia Space (2005). *Eurely takes a further step toward Galileo concession*, 15 septembre 2008.

Avant, D. D., Finnemore, M. and Sell, S. K., (eds) (2010). *Who Governs the Globe?*, Cambridge: Cambridge University Press.

Barlier, F., (ed.) (2008). *Galileo. Un enjeu stratégique, scientifique et technique*, Paris: L'Harmattan.

Beeson, M. and Bell, S. (2009). "The G-20 and International Economic Governance: Hegemony, Collectivism, or Both?", *Global Governance* 15(1): 67-86.

Bildt, C., Peyrelevade, J. and Spath, L. (2000). *Towards a Space Agency for the European Union*, Paris: ESA.

Blanchard, W. F. (2003). "Achieving GPS–Galileo interoperability: the challenges ahead", *Space Policy* 19: 95-99.

Blind, K. and Egyedi, T. (eds) (2008). *The dynamics of standards*, Cheltenham: E. Elgar.

Blyth, M. (ed.) (2009). *Routledge handbook of international political economy (IPE): IPE as a global conversation*, London: Routledge.

Borraz, O. (2007). "Governing standards : the rise of standardization processes in France and in the EU", *Governance* 20(1): 57-84.

Braithwaite, J. and Drahos, P. (2000). *Global Business Regulation*, Cambridge: Cambridge University Press.

Brunsson, N., Jacobsson, B. and Associates (2000). *A World of Standards*, Oxford: Oxford University Press.

Büthe, T. (2010). "Private Regulation in the Global Economy: A (P)Review", *Business and Politics* 12(3).

Callon, M. (1991). 'Techno-economic Networks and Irreversibility', in Law, J. (ed.) *A Sociology of Monsters: Essays on Power, Technology and Domination*, London: Routledge.

Cameron, A. and Palan, R. (2009). "Empiricism and objectivity: Reflexive theory construction in a complex world', in Blyth, M. (ed.) *Routledge Handbook of International Political Economy : IPE as a global conversation*, London: Routledge.

Cargill, C. F. (1989). *Information Technology Standardisation*. *Theory, Process and Organisations*, Bedford MA: Digital Press.

Clapp, J. (1998). "The Privatization of Global Environmental Challenge: ISO 14000 and the Developing World", *Global Governance* 4: 295-316.

Cohen, B. J. (2007). "The transatlantic divide: Why are American and British IPE so different?", *Review of International Political Economy* 14(2): 197 - 219.

Coste, O. (2005). *Intervention dans la première table ronde « L'Europe spatiale dans la compétition internationale »*. *Actes du colloque « Vers une nouvelle Europe spatiale » du 17 juin 2005*, Paris & Bruxelles: Fondation Robert Schuman: 22-24.

Council of the European Union (2002). *Council Regulation (EC) No 876/2002 of 21 May 2002 setting up the Galileo Joint Undertaking*.

Cour des Comptes Européenne (2009). *La gestion de la phase de développement et de validation du programme Galileo*: Cour des Comptes Européenne. Rapport spécial n° 7/2009.

Cowan, R. S. (1991). "Tortoises and Hares: Choice Among Technologies of Unknown Merit", *Economic Journal* 101: 801-14.

Cox, R. W. (1987). *Production, Power and World Order*. *Social Forces in the Making of History*, New York: Columbia University Press.

Cox, R. W. (1992). 'Global *Perestroïka*', in Miliband, R. and Panitch, L. (eds) *Socialist Register*, London: Merlin Press.

Creti, A. and Perrot, A. (1997). "Les entreprises en réseaux", in Perrot, A. (ed.) *Réglementation et concurrence*, Paris: Economica.

Cutler, A. C., Haufler, V. and Porter, T., (eds) (1999). *Private Authority and International Affairs*, New York: SUNY Press.

David, P. A. (1995). "Standardization policies for network technologies: the flux between freedom and order revisited", in Hawkins, R., Mansell, R. and Skea, J. (eds) *Standards, Innovation and Competitiveness*, Aldershot: E.Elgar.

Desingly, A., (ed.) (2006). *Galileo, la navigation européenne, questions juridiques et stratégiques au temps de la concession*, Travaux de recherche de l'IFRI, Paris: La Documentation française.

Djelic, M.-L. and Sahlin-Andersson, K., (eds) (2006). *Transnational Governance*. *Institutional Dynamics of Regulation*, Cambridge: Cambridge University Press.

Djelic, M.-L. and Quack, S., (eds) (2010). *Transnational Communities*. *Shaping Global Economic Governance*, Cambridge: Cambridge University Press.

Drèze, J. (1989). 'The Standard Goods Hypothesis', in Jacquemin, A. and Sapir, A. (eds) *The European Internal Market*, Oxford: Oxford University Press.

Dudouet, F.-X., Mercier, D. and Vion, A. (2006). 'Politiques internationales de normalisation: Quelques jalons pour la recherche empirique', *Revue Française de science politique* 56(3): 367-392.

EADS (2005). *iNavSat, 40 partenaires en lice pour la concession Galileo*. *European Aeronautic Defence and Space Company EADS N.V.*, 15 septembre 2008.

Egan, M. (2001). *Constructing a European Market*. *Standards, Regulation, and Governance*, Oxford: Oxford University Press.

Engelsberg, V., Petrovski, I. and Babakov, V. (2008) *GLONASS business prospects*. *GPS World*, March.

Eurely & Inavsat (2005a) 'Eurely and iNavSat applaud today's GJU decision for the Galileo Concession', *Eurely & Inavsat* 25 June.

Eurely & Inavsat (2005b). 'Eurely and iNavSat consortia deliver a joint proposal for the Galileo concession', *Eurely & Inavsat* 20 June.

European Commission (1994). *Satellite navigation services: a European approach*, Brussels: European Commission.

European Commission (1996). *The European Union and space: fostering applications, markets and industrial competitiveness*, Brussels: European Commission.

European Commission (2006). *Communication from the Commission to the European Parliament and the Council. Taking stock of the Galileo programme*: European Commission.

European Commission (2007). *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Galileo at a cross-road: The implementation of the European GNSS programmes*: European Commission. COM(2007) 261.

European Commission (2008). *Work Programme 2008 for the further implementation of the European satellite radio-navigation programmes (EGNOS and Galileo), including the Programme Implementation Plan*: European Commission.

European GNSS Supervisory Authority (2009a). *Galileo – Benefits*, 20 August.

European GNSS supervisory Authority (2009b). *Why Galileo*, 20 August.

European Parliament and Council of the European Union (2008). *Regulation (EC) No 683/2008 of 9 July 2008 on the further implementation of the European satellite navigation programmes (EGNOS and Galileo)*.

European Space Agency (2005). *Galileo: The European Programme for Global Navigation Services*, Noordwijk: ESA.

European Union (2008). *Consolidated versions of the Treaty on European Union and the Treaty on the Functioning of the European Union*. 2008/C 115/01.

European Union & United States of America (2004). *Agreement on the promotion, provision and use of Galileo and GPS satellite-based navigation systems and related applications*.

Flament, P. and Ludwig, D. (2003). 'Galileo: Status and Way Forward', in Rycroft, M. J. (ed.) *Satellite Navigation Systems: Policy, Commercial and Technical Interaction. Space Studies*, Dordrecht: Kluwer Academic Publishers.

Germain, R. D. and Kenny, M. (1998). 'Engaging Gramsci: International Theory and the New Gramscians', *Review of International Studies* 24(1): 3-21.

Grande, E. and Pauly, L. W., (eds) (2005). *Complex sovereignty*. *Reconstituting political authority in the twenty-first century*, Toronto: University of Toronto Press.

Graz, J.-C. (2006). 'International standardisation and corporate democracy', in Giesen, K.-G. and Pijl, K. v. d. (eds) *Global Norms in the Twenty-First Century*, Cambridge: Cambridge Scholars Press.

Graz, J.-C. and Nölke, A., (eds) (2008). *Transnational Private Governance and its Limits*, London: Routledge.

Harrison, M. (2001). 'Cabinet divided on Galileo satellite project', *The Independent* 3 December.

Hay, C. and Marsh, D. (1999). 'Introduction: Towards a New (International) Political Economy', *New Political Economy* 4(1): 5-22.

Heires, M. (2008). 'The International Organization for Standardization (ISO)', *New Political Economy* 13(3): 357-367.

HLIWG (1996). *Development and competitiveness of space industries in Europe*, Brussels: HLIWG.

Inside GNSS (2007). *GLONASS has "preliminary approval" to transmit CDMA GLONASS signals at L1, L5*. *Inside GNSS*, 21 December 2009.

International Committee on Global Navigation Satellite Systems (2009). *Report of the Working Group A on Compatibility and Interoperability*, St-Petersburg/Vienna: UN Office for Outer Space Affairs, 14-18 September.

Jordana, J. and Levi-Faur, D., (eds) (2005). *The Politics of Regulation*. *Institutions and Regulatory Reforms for the Age of Governance*, Cheltenham: E.Elgar.

Kennes, B., Blasi, R. and Boullete, F. (2009). *GNSS market monitor*: European GNSS Supervisory Authority (GSA).

Krause Hansen, H. and Salskov-Iversen, D., (eds) (2008). *Critical Perspectives on Private Authority and Global Politics*, Houndmills: Palgrave Macmillan.

Lewis, J. A. (2004). *Galileo and GPS: from competition to cooperation*, Washington: Center for Strategic and International Studies.

Liebowitz, S. J., Margolis, S. and Lewin, P. (2002). *The economics of QWERTY*. *History, Theory, and Policy*, New York: New York University Press.

Lindström, G. and Gasparini, G. (2003). *The Galileo satellite system and its security implications*, Paris: EU Institute for Security Studies.

Lungu, S. (2004). 'Power, Techno-Economics, and Transatlantic Relations in 1987-1999: The Case of Airbus Industrie and Galileo', *Comparative Strategy* 23(4): 369-389.

Majone, G., (ed.) (1996). *Regulating Europe*, London: Routledge.

Mattli, W. and Woods, N. (2009). 'In Whose Benefits? Explaining Regulatory Change in Global Politics', in Mattli, W. and Woods, N. (eds) *The Politics of Global Regulation*, Princeton: Princeton University Press.

Mattli, W. and Buthe, T. (2011). *The New Global Rulers*. *The Privatization of Regulation in the World Economy*, Princeton: Princeton University Press.

Mattli, W., (ed.) (2001). *Governance and International Standards Setting. Special Issue of the Journal of European Public Policy*. Vol. 8:3.

Mörth, U. (2007). 'Public and Private Partnerships as Dilemmas between Efficiency and Democratic Accountability: The Case of Galileo', *Journal of European Integration* 29(5): 601–617.

Mügge, D. (2006). 'Reordering the Marketplace: Competition Politics in European Finance', *Journal of Common Market Studies* 44(5): 991-1022.

Murphy, C. and Yates, J. (2009). *The International Organization for Standardization (ISO)*. *Global Governance through Voluntary Consensus*, London: Routledge.

Nicolaïdis, K. and Egan, M. (2001). 'Transnational market governance and regional policy externalities: why recognize foreign standards?', *Journal of European Public Policy* 8(3): 454-473.

OACI (2004). *Céation des normes de l'OACI*: Organisation de l'aviation civile internationale. P715.

OECD (1999). *Regulatory Reform and International Standardisation*, Paris: Organization for Economic Cooperation and Development, Trade Committee Working Party.

Peltzman, S. (1974). 'Toward a More General Theory of Regulation', *Journal of Law and Economics* 19: 211-40.

Phillips, N. and Weaver, C., (eds) (2010). *International Political Economy*. *Debating the Past, Present and Future*, London: Routledge.

Piéplu, J.-M. and Salvatori, O. (2006). *GPS et Galileo : Systèmes de navigation par satellites*, Paris: Eyrolles.

Prakash, A. and Potoski, M. (2010). 'The International Standards Organization as a global governor: a club theory approach', in Avant, D. D., Finnemore, M. and Sell, S. K. (eds) *Who Governs the Globe?*, Cambridge: Cambridge University Press.

Sample, I. (2007). 'MPs demand cost review of delayed Galileo satellite system', *The Guardian* 12 November.

Sassen, S. (2006). *Territory, Authority, Rights*. *From Medieval to Global Assemblages*, Princeton: Princeton University Press.

Schmidt, S. K. and Werle, R. (1998). *Coordination Technology*. *Studies in the International Standardization of Telecommunication*, Cambridge (MA): MIT Press.

Sparaco, P. (2003). *New German Demands Block Galileo Go-Ahead*. *Aviation Week & Space Technology*. 6 January.

Stigler, G. (1971). 'The Theory of Economic Regulation', *Bell Journal of Economics* 2: 113-121.

Swann, G. M. P. (2000). *The Economics of Standardization. Final Report for Standards and Technical Regulations Directorate Department of Trade and Industry*, Manchester: Manchester Business School, 11th December.

Toth, R. B. (1984). *The Economics of Standardization*, Minneapolis: Standards Engineering Society.

Vogel, D. (2009). 'The Private Regulation of Global Corporate Conduct ', in Mattli, W. and Woods, N. (eds) *The Politics of Global Regulation*, Princeton: Princeton University Press.

Vogel, D. and Kagan, R., (eds) (2004). *The Dynamics of Regulatory Change*. *How Globalization Affects National Regulatory Policies*, Berkeley: University of California Press.

Vries, H. d. (1999). *Standardization*. *A Business Approach to the Role of National Standardization Organizations*, Boston: Kluwer.

Wilson, J., (ed.) (1980). *The Politics of Regulation*, New York: Basic Books.

Zervos, V. and Siegel, D. S. (2005). 'The importance of co-ordination in national technology policy: Evidence from the Galileo project', *Prometheus* 23(2): 167-180.

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